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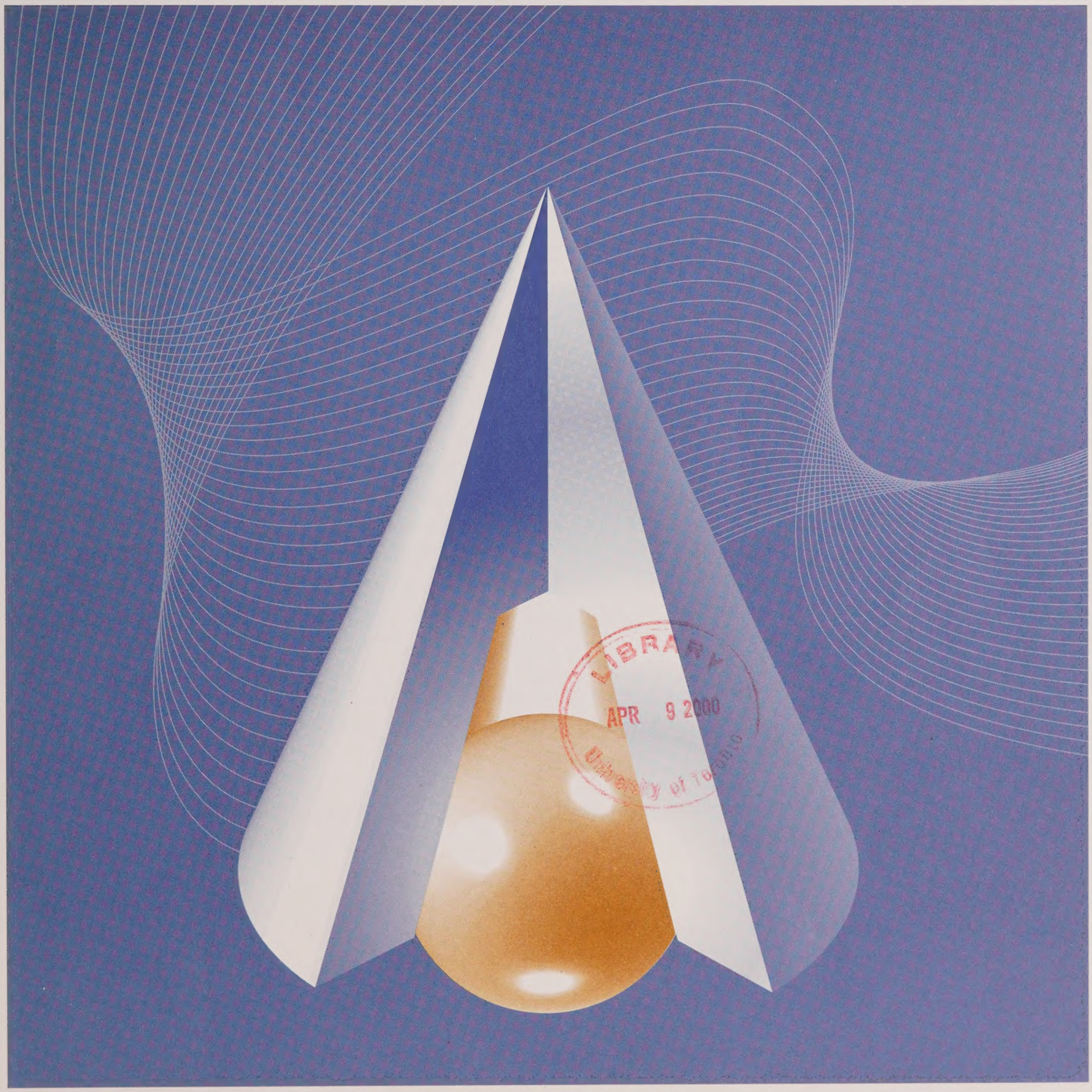
*Training as a Human Resource Strategy: The Response to Staff Shortages and Technological Change*

by John R. Baldwin and Valerie Peters

**No. 154**





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# Table of Contents

## *Abstract*

This paper examines the ways that *innovation status* as opposed to *technology-use status*—affects the training activities of manufacturing plants. It examines training that is introduced as a response to specific skill shortages versus training that is implemented in response to the introduction of advanced equipment.

We find that advanced technology users are more likely to have workers in highly skilled occupations, to face greater shortages for these workers, and they are more likely to train workers in response to these shortages than are plants that do not use advanced technologies.

The introduction of new techniques is also accompanied by differences in the incidence of training, with advanced technology users being more likely to introduce training programs than non-users. Here, innovation status within the group of technology users also affects the training decision. In particular, innovating and non-innovating technology users diverge with regards to the extent and nature of training that is undertaken in response to the introduction of new advanced equipment. Innovators are more likely to provide training for this purpose and to prefer on-the-job training to other forms. Non-innovators are less likely to offer training under these circumstances and when they do, it is more likely to be done in a classroom, either off-site or at the firm.

These findings emphasize that training occurs for more than one reason. Shortages related to insufficient supply provide one rational. But it is not here that innovative firms stand out. Rather they appear to respond differently to the introduction of new equipment by extensively implementing training that is highly firm-specific. This suggests that innovation requires new skills that are not so much occupation specific (though that is no doubt present) but general cognitive skills that come from operating in an innovative environment that involves improving the problem-solving capabilities of many in the workforce. These problem-solving capabilities occur in a learning-by-doing setting—with hands on experience.



**Keywords:** Training, innovation, advanced technology

# 1. Introduction

Productivity growth depends on the implementation of new technologies and the development of new innovative products. Yet, evidence from the 1993 Survey of Innovation and Advanced Technology indicates that only 35% of Canadian manufacturing establishments made use of advanced technologies (Baldwin and Sabourin, 1995). Only 40% of large manufacturing firms were found to be innovators (Baldwin and Da Pont, 1996).

According to managers of manufacturing plants, one of the principal impediments to both technology use and to innovation is the lack of skilled workers (Baldwin and Sabourin, 1995, and Baldwin, 1997). This paper investigates how manufacturing plants respond to these shortages.

Both technology use and innovation increase the need for highly skilled employees (Baldwin and Johnson, 1996a; Baldwin, Gray and Johnson, 1996; Baldwin and Da Pont, 1996). The importance of being able to hire, retrain and retain workers who have the necessary skills to work with advanced technologies cannot be understated. Firms who are adopting and using ever-more advanced technologies, who are continually working to improve the quality of their products, and who are striving to be first-to-market with new products require a workforce that is adaptable, skilled, and educated. They can meet new skill needs in one of two ways: by recruiting new higher-skilled employees or by imparting new skills to existing employees. Of course, these are not mutually exclusive options. A firm can both train and recruit.

The decision to hire or to train is influenced by a variety of factors. One is the nature of the skills required. If the need is for more generic skills that are readily available in outside labour markets, firms might be more inclined to hire new staff. Conversely, plant-specific (tacit) knowledge is difficult to find outside the firm; thus training existing staff is more likely to be the preferred option in this case (Baldwin, Gray and Johnson, 1996). The experiences of a firm and the human resource competencies developed through experience also play a role in future success. Past success or failure with either approach will influence a decision on whether to hire or to train. Similarly, the various strategies being pursued in areas other than human resources—management, marketing, technology, and innovation—will affect a firm's disposition to recruit, train or do both.

Previous research has shown that both innovation and technological change are associated with an increased emphasis on human resources.[1] When manufacturing businesses adopt new technologies or innovate, they are likely to upgrade the skill level of their employees—either through recruitment or training. The current study investigates the interplay between the use of advanced technology and innovation and the human resource strategies that a firm pursues. Specifically, our interest is in how manufacturing plants with different technological and innovation profiles respond to (i) staff shortages and, (ii) the introduction of new technologies onto the plant floor.

[1] See Baldwin (1999) for a survey.

The study distinguishes between those plants who are using advanced technologies and those who are doing so as well as introducing new products and processes. The distinction here is one of the degree of innovation. The first group (the technology users) are introducing new machines. But the second group also engineer new processes and products. The latter might be said to involve more originality. In this paper, we investigate whether the two groups differ in their need for training programs.

We find that both innovators and advanced technology users are more likely to train workers in response to skill shortages and to the introduction of new techniques, than are firms that do neither. But innovators are more likely to provide training when introducing new technologies and to prefer on-the-job training. Innovators prefer training that is highly firm-specific. Innovation requires new skills that are not so much occupation specific but general cognitive skills that come from operating in an innovative environment that involves improving the problem-solving capabilities of employees.

The report is in three parts. It begins with a brief discussion of the data source and then moves to outline issues and our expectations related to the results. The third section presents the findings.

## 2. The Survey of Innovation and Advanced Technology

Our source of data on technology use and training practices of individual Canadian plants is the *1993 Survey of Innovation and Advanced Technology,* which asked large and small manufacturing firms and their plants an extensive series of questions on a broad range of issues. Of the five broad areas covered (general characteristics, research and development, innovation, intellectual property and technology use), this paper focuses on two—innovation and technology use. The response rate for the survey was 85.5%. The questions that are used here are reported in Appendix B.

The technology use section of the survey included questions on problems associated with technology adoption (including human resource related problems), on skill shortages and responses to them, and on training associated with the adoption of technology. In order to examine how the stress placed on skilled workers is related to technology use, the data from the survey were separated into technology users and non-users. Technology users were those plants that had adopted any one of 22 advanced technologies that were covered by the survey—ranging from new technologies in design and engineering, fabrication and assembly, inspection and communications, to integration and control. The technologies that were used are listed in Table 1.

For the purposes of this study, we also subdivide technology users into two groups—those who are more and less innovative. This is done by dividing the advanced technology users into those who were also introducing major new products or developing brand new production techniques with the new technologies. The innovation status of a firm was derived from responses to a series of questions: asking whether the firms had produced new products resulting from major innovations, or if new processes had been introduced (see Appendix B).

**Table 1.** Advanced Manufacturing Technologies

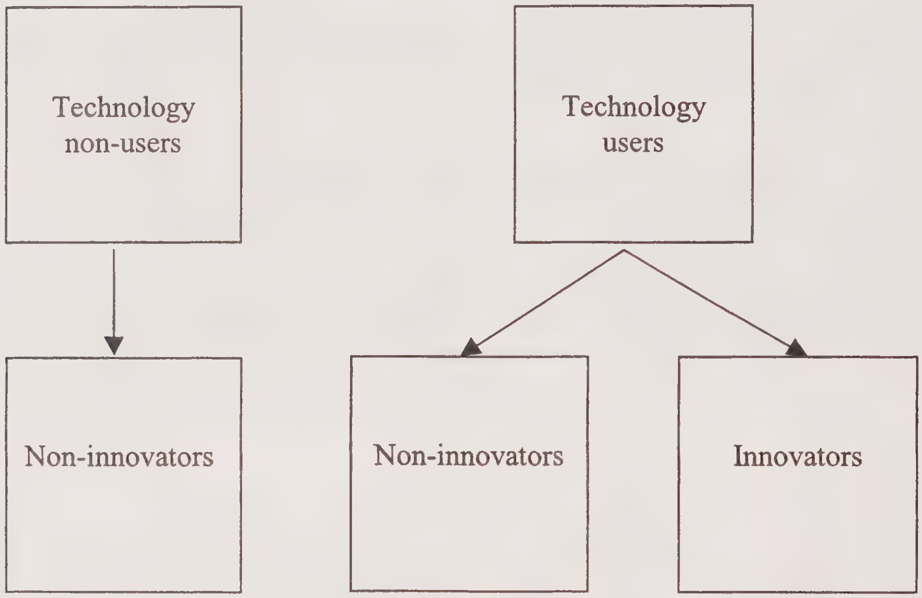
| Functional Group | Technology | Description |
|---|---|---|
| **Design and Engineering** | • Computed-aided design/engineering | • Use of computers for drawing and designing parts or products (CAD/CAE) |
| | • CAD output to control manufacturing | • Use of CAD output for controlling manufacturing machines |
| | • Digital representation of CAD output | • Use of digital representation of CAD output for controlling manufacturing machines |
| **Fabrication and Assembly** | • Flexible manufacturing cells/systems | • Machines with fully integrated material handling capabilities controlled by computers or programmable controllers |
| | • Numerically controlled and computer numerically controlled machines | • A single machine numerically/computer-numerically controlled with/without automated material handling capabilities |
| | • Materials working lasers | • Laser technology used for welding, cutting, treating, scribing and marking |
| | • Pick and place robots | • A simple robot which transfers items from one place to another |
| | • Other robots | |
| **Automated Material Handling** | • Automated storage/retrieval systems | • Computer-controlled equipment for the automatic handling and storage of materials, parts, sub-assemblies or finished products |
| | • Automated guided vehicle systems | • Vehicles equipped with automatic guidance devices |
| **Inspection and Communications** | • Automatic inspection equipment for incoming materials | • Automatic sensor-based equipment used for inspecting or testing incoming or in-process materials |
| | • Automatic inspection equipment for final products | • Automatic sensor-based equipment used for inspecting/testing final products |
| | • Local area network for technical data | • Use of local area network (LAN) to exchange technical data with design and engineering departments |
| | • Local area network for factory use | • Use of LAN to exchange information between different points on the factory floor |
| | • Inter-company computer network | • Networks connecting establishments with sub-contractors, suppliers and customers |
| | • Programmable controllers | • Control device that has programmable memory for storage of instruction |
| | • Computers used for control in factories | • Computers on the factory floor that may be dedicated to control, but which are capable of being reprogrammed for other functions |
| **Manufacturing Information Systems** | • Materials requirement planning | • Computer-based production management and scheduling system to control order quantities, inventory and finished products |
| | • Manufacturing resource planning | • Computer-based production management of machine loading and production scheduling, as well as inventory control and material handling |
| **Integration and Control** | • Computer integrated manufacturing | • All manufacturing processes are integrated and controlled by a central computer |
| | • Supervisory control and data acquisition | • On line, computer-based monitoring and control of process and plant variables at a central site |
| | • Artificial intelligence/expert systems | • A machine performing tasks normally attributed to human intelligence/the computerization of knowledge of experts in narrowly defined fields, e.g., fault finding |

This allows us to divide the technology-using/non-using groups into innovator and non-innovator groups. Plants can then be classified as technology users and non-users and as innovative and non-innovative.[2] Of the four groups thus created, three are used here: 1) technology non-using, non-innovative firms—hereafter referred to simply as technology non-users[3]; 2) technology-using innovative firms; and, 3) technology-using non-innovative firms.[4]

Comparison of the human resource strategies of the first category to the second and third allows us to ascertain the effect of technology use on these strategies; comparison of the second and third group allows us to ascertain the effect of being more innovative within the technology-using group.

Our taxonomy is depicted in the diagram below.

**Figure 1. The technology/innovation classification scheme**




[2] We recognize that non-innovative firms as defined here are not devoid of innovations. The technology-using non-innovators are at least using advanced technologies. But they do not feel that they are introducing new products or dramatically new production techniques. Our classification system, in effect, divides firms into those who are more and less innovative. For the purpose of brevity of expression, we refer to these less innovative technology users as non-innovative in the text.

[3] They will, of course, use some advanced equipment; they will not be using the new advanced technologies that were investigated in this survey.

[4] The fourth group—technology non-users who were innovative—had so few observations that it was omitted.

We will examine whether differences in skill shortages existed for these different groups and the manner in which these shortages were addressed. In order to examine this issue, we use information from the survey relating to 18 professional groups. These are:

Electrical engineers, aerospace engineers, engineering technologists and technicians, systems analysts and computer programmers, electronic data processing equipment operators, assemblers of printed circuit boards, CAD draught persons, CAD/CAM repair technicians, CAD designers of printed circuit boards, computer hardware specialists, fibre-optic splicers, laser-beam welders, laser-tube assemblers, machinists for numerically controlled machine tools, microcomputer specialists, numerical-control operators, and robotic technicians. The categories were chosen in consultation with labour market occupations experts and were meant to be representative of skilled occupations that are associated with advanced technology use rather than exhaustive of all such occupations.[5]

Plant managers were asked whether they possessed employees in these groups, whether they had experienced shortages and how they had addressed these shortages. They were also asked whether they trained their employees when they introduced new equipment (advanced or otherwise) and whether government assistance was used to implement their training programs. Each of these will be investigated in turn to ascertain whether technology non-users and technology users (both innovative and non-innovative) differ with regards to the human resource problems that they faced and the solutions that were implemented.

For the purposes of our analysis, the original 18 professional groups have been grouped into four—professionals with a university degree, technicians and technologists, skilled trades and other.[6] The "other" category is omitted from the discussion here due to problems with its interpretation.

Similarly, the subcategories to the question that asked whether training occurred with or without government assistance and which level of government provided the assistance have been omitted since the response rate to this part of the training question was low. We focus here only on whether training programs were implemented.

Finally, it should be noted that all data presented have been establishment weighted so as to represent population estimates.

[5] We are indebted to Can Le for this task.

[6] These are *Professionals with university degree*: electrical engineers, aerospace engineers, systems analysts and computer programmers; *Technicians/technologists*: engineering technologies and technicians, CAD draughts persons, CAD/CAM repair technicians, CAD designers, printed circuit boards, computer hardware specialists, microcomputer specialists, robotics technicians; and *Skilled trades* are electronic data processing equipment operators, assemblers, printed circuit boards, fibre-optic cable splicers, laser-beam welders, laser-tube assemblers, machinists of numerically controlled tools, numerical control operators.

## 3. The Innovation-Technology Link

Previous research into the barriers that firms encountered when pursuing advanced technological strategies has shown that technology users face more and different problems than do non-users (Baldwin, Sabourin, and Rafiquzzaman, 1996). It is by introducing an innovation or adopting a technology that businesses learn about the severity of the management problems that they must solve.[7] In turn, innovative firms or technology users acquire the competencies necessary for effectively innovating or adopting new advanced technologies. In doing so, they generally give greater emphasis to a wide range of capabilities—in areas of finance, marketing, human resources and management (Baldwin and Johnson, 1996b, 1999).

One of the competencies to which plants with advanced technological capabilities give greater emphasis is a skilled labour force. Using data from the *1989 Survey of Advanced Technology*, Baldwin, Gray and Johnson (1996) show that users of advanced manufacturing technologies are more likely to train than non-users. Using the *1993 Innovation and Advanced Technology Survey*, Baldwin and Sabourin (1997) report that plants experience a substantial increase in their training costs as a result of the adoption of advanced technologies.

Innovation also leads firms to place more emphasis on ensuring a skilled workforce. Baldwin and Johnson (1996a) use data on small- and medium-sized firms from the *Growing Small and Medium-Sized Survey* to show that the emphasis on human resources is positively related to innovative activity. Similarly, using data from the *1993 Survey of Innovation and Advanced Technology,* Baldwin and Da Pont (1996) report that skill requirements increase as the result of innovation, and the more innovative a firm is, the greater the increase in the skill levels required.

In this paper, we examine the extent to which this greater need for skills in technology and innovative firms arises from skill shortages in particular occupations. The type of staff needed by a firm to conduct normal operations is, in part, determined by the nature of the firm's business. Manufacturing firms that have relatively simple production processes or that do not often introduce new products likely have less need for highly skilled or highly educated staff. In contrast, plants that specialize in introducing new products or producing high-tech products are hypothesized to have a greater need for such workers.

For both goods and service sectors, we have previously found that the occupational structure of a firm is related to its innovation stance—when innovation is broadly defined.[8] More innovative firms employ a larger percentage of professional and technical/production staff (Baldwin and Johnson, 1995). Whether or not this relationship holds when innovation is more narrowly defined and when firms are restricted to the manufacturing sector, as is the case here, is examined in this paper.

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[7] See also Baldwin and Lin (2001).

[8] Baldwin and Johnson (1996a) and Baldwin, Gellatly, Johnson and Peters (1998) present evidence that innovation is not a uni-dimensional characteristic of a firm but is a combination of competencies and strategies which have variety of outcomes.

On one hand, we might expect it also to be true in manufacturing because innovative firms, regardless of the industry in which they operate, require a broader and deeper skill set than do non-innovators, because of how they do what they do. On the other hand, the relationship might not hold because all respondents to the *1993 Survey of Innovation and Advanced Technology* operated in the same industry—manufacturing—and, thus, tend to have similar pressures to find skilled workers.

Similarly, it is difficult to predict, *a priori,* which of the three groups (technology non-users, innovative technology-users, and non-innovative technology-users) will experience the most difficulties when trying to fill staff positions—especially if problems that arise are more related to economy wide skill shortages than to the activities and capabilities of any particular plant.

Occupational structures are not the only characteristics that will influence the need to train. Technology acquisition is also important. Baldwin and others, drawing from various Statistics Canada surveys, have shown that there is a strong link between technology use, innovation, and the training performed by a firm.[9] Training is much more likely among innovating firms and among firms using advanced technologies. This is due to the specific type of knowledge required and the rapidity of change they experience. Baldwin and Johnson (1996a), using data gathered from small- and medium-sized firms in both goods and services industries, report that an emphasis on a high-tech strategy strongly influences a firm's tendency to train, especially in manufacturing. Since we are dealing here with the manufacturing sector, we would expect to see strong differences between technology users and non-users; but, based on our previous research, the strength of the additional differences to be found within technology users between non-innovative and innovative plants is less clear.

These latter differences between innovative as opposed to non-innovative technology users, may develop from several different factors. On the one hand, they may result from differences in skill shortages in the two groups that occur in a narrow range of highly skilled occupations. Or they may be caused by differences in knowledge requirements that are common to all employees. If it is the former, we will find that the more innovative firms are more likely to provide training in response to specific skill shortages. If it is the latter, we would expect to find little difference between innovative and non-innovative plants in the use of training as a response to specific skill shortages and more difference in the general strategy of training in response to the adoption of advanced equipment. We would also expect to see differences in the types of training being offered. Innovative firms might be expected to offer highly firm-specific training since their problems are more idiosyncratic in that they relate to innovation—which creates more firm-specific problems than are faced by non-innovative firms that are more likely to just be buying off-the-shelf technologies. The problems encountered by the latter are more likely to involve the type of generic knowledge that a machinery supplier will provide to its customers about its machinery.

The third group of manufacturing firms discussed here—plants that neither use advanced technologies nor are innovative—should have a quite different human resource profile. Because they lack experience in both innovating and in adopting advanced technologies, their perspective on

[9] See Baldwin (1999) for a survey of this research.

impediments to these activities should also be different. Given the association between innovation, technology use and increased skill levels, the occupational breakdown in technology non-users should also diverge from the two technology-using groups and give rise to fewer skill shortages and less training. Similarly, we would expect them to not only be less likely to train staff but also to offer different types of training when they implement these programs—to offer more generic and less firm-specific training than that associated with an innovation strategy.

## *4. Staff Shortages, New Technologies and Training*

Training may be required for the general upgrading of skills that are needed to introduce advanced technologies. Higher skill requirements may pertain equally to managers who must oversee a more complex organization, to scientists who must solve more complex technological problems, and to production workers who have to run more complex equipment in organizations that use advanced technologies. But training requirements may also differ across these occupational groupings. In this section, we examine the differences in specific occupational needs, the shortages that exist in each, and the responses that were adopted to solve these shortages.

***Filling Highly-skilled Positions***

In order to examine the prevalence of skilled occupations across our grouping of firms, we report the percentage of plants with workers in any of the three classes used here—professionals with a university degree, technicians and technologists, and skilled trades (Table 2). Tests for differences across the categories are provided in Appendix A.

As was expected, both of the technology-using groups are more likely to have staff in these skilled groups than non-users. While highly skilled staff positions are found in technology non-users (between 40% and 60% have positions in at least one of the three occupational groups), these plants are far less likely than are technology-using plants to have these positions. This confirms that technology use and skill requirements are related.

However, innovators are not generally more likely to have highly skilled staff than non-innovators within the technology-using group. Among innovating and non-innovating firms using advanced manufacturing technologies, the proportions with positions in two of the three occupational groups—professionals with university degrees and technicians/technologists—are almost identical.[10] This suggests that if there are additional skill requirements in innovators, these requirements do not so much lie in the need to have more of the specific occupations that are represented by our 18 categories; rather it might lie in more firm-specific knowledge that everyone is required to master in an innovative environment.

[10] A fourth category, "other", given that it is a catch-all category, which might or might not include management, marketing, administrative and/or other groups of employees, is not discussed here.

In this same vein, it is also noteworthy that there are significantly fewer innovative plants indicating that they have positions in the skilled trades group—61 % of technology-using innovators have this type of position compared to 77% of technology-using non-innovators. These skills are usually associated with production processes. That our innovative group possesses fewer of them suggests that process innovations are less important for these firms and, therefore, that they are more inclined towards product innovations. In turn, this implies that innovative technology-using firms are more likely to be located in the earlier phase of the product life-cycle, when product rather than process innovation is stressed, when devising new products is more important than introducing process efficiencies, when competition takes place around new products rather than around a lower price that requires production efficiencies in order to lower costs.

**Table 2.** Plants with highly-skilled staff positions

| | Technology non-users | Technology-using innovators | Technology-using non-innovators |
|---|---|---|---|
| | *Percentage of plants with one or more staff positions (standard errors in brackets)* | | |
| Professionals with university degree | 44.1 | 62.5 | 62.5 |
| | (4.1) | (2.2) | (8.4) |
| Technicians/technologists | 62.9 | 87.7 | 83.2 |
| | (3.9) | (1.5) | (7.1) |
| Skilled trades | 49.7 | 60.6 | 77.3 |
| | (4.1) | (2.2) | (7.0) |

In summary, the need for highly skilled or educated staff (at least in the categories examined here) is driven more by the use of advanced technology than it is by innovation. Technology-using firms are far more likely to have staff positions that demand highly skilled employees than are technology non-users, regardless of their innovation status.

### *Shortages of Skilled Workers*

Much has been written about the need for adequate supplies of highly skilled workers in the knowledge-based economy (OECD, 1998). The debate in Canada has centered on whether the ability of Canadian firms to be competitive on world markets has been deterred by a shortage on the type of highly-skilled workers needed in an innovative, knowledge-based economy. Gingras and Roy (1998), argue that there is no evidence of a *widespread* deficiency in Canada. In this section, we examine whether firms felt there were *specific* areas that hampered them.

If shortages of skilled staff exist, then technology use and innovation will be hampered. In order to investigate the severity of this problem, the survey asked firms that possessed staff positions in these skilled groups whether they had experienced shortages.[11] The data on staff shortages in the

[11] It should be noted that firms that did not have positions filled or open were not asked this question. This may underestimate the nature of the shortage problem. However, the method that has been used here is probably the best way to judge what the shortages are. We have found that firms that do not engage in an activity—such as technology acquisition—have a very poor idea of the problems that are associated with such an activity (see Baldwin and Lin, 2001). Therefore, firms that do not have positions are not likely to have a good idea as to whether the positions are hard to fill.

groups examined here (Table 3) allow us to see whether skill shortages are widespread and if the problems that did exist in filling positions varied across technology non-users and technology users.

The first conclusion that we draw is that, in 1993, few plants experienced difficulty staffing existing positions in the three broad occupational groups considered here. Skill shortages are not very important—at least with regards to the categories examined here. This may be explained by several factors. First, the group of occupations chosen may miss critical areas. Second, the skill problem is related not so much to specific skills as to more general knowledge that is not occupation-specific. Finally, the economy in the early 1990s, when this survey was taken, experienced high unemployment rates and may have had an excess supply even in skilled occupations. Gingras and Roy (1998) note that only 2% to 4% of manufacturers reported that they experienced difficulties hiring skilled labour during the years 1991-93.[12] It should be noted that the skill shortages reported in Table 3 in technology-using plants are higher than those that Gingras and Roy report for the manufacturing sector as a whole.

**Table 3.** Plants with staff positions who had difficulty staffing them

| | **Technology non-users** | **Technology-using innovators** | **Technology-using non-innovators** |
|---|---|---|---|
| | *Percentage of plants with difficulty filling one or more positions (standard errors in brackets)* | | |
| Professionals with university degree | 3.7 | 7.2 | 5.2 |
| | (1.7) | (1.1) | (3.8) |
| Technicians/technologists | 5.0 | 15.4 | 11.3 |
| | (2.0) | (1.6) | (6.6) |
| Skilled trades | 1.2 | 7.4 | 7.4 |
| | (1.2) | (1.1) | (5.6) |

It is noteworthy that technology-using plants were more likely to experience staffing problems than were technology non-users.[13] This is particularly true for the skilled trade and technician/technologist occupational groups. Among plants with skilled trade positions, only 1% of technology non-users had difficulty staffing, compared to 7% of technology-using innovative plants and 7% of technology-using non-innovative plants. Differences are also found for the technicians/technologists group. This suggests that the skills required for technicians in technology non-users are different and in greater supply than for technology-using firms.

In terms of staffing difficulties, there is little to distinguish technology-using innovators from technology-using non-innovators. While the more innovative technology users encountered more difficulty in staffing skilled positions than non-innovative technology users, the differences are not statistically significant. For technology-using plants, innovation does not greatly affect either the likelihood that they possess workers in the occupations examined here or that they face shortages in these positions.

[12] The data are taken from Statistics Canada's *Business Conditions Survey*.
[13] Tests of statistical significance for these differences are provided in Appendix A.

**Table 4.** Steps taken by firms with difficulty staffing highly-skilled positions

| | Technology non-users | Technology-using innovators | Differences (probabilities in brackets)[a] |
|---|---|---|---|
| | *Percentage of plants (standard errors in brackets)* | | |
| Deferred technology acquisition | 17.1 | 17.4 | -0.3 |
| | (9.5) | (3.4) | (0.99) |
| Sub-contracted | 62.6 | 57.8 | 4.8 |
| | (14.5) | (4.5) | (0.93) |
| Provided appropriate training | 53.7 | 62.3 | -8.6 |
| | (14.5) | (4.5) | (0.57) |
| Improved wages, benefits | 24.5 | 12.0 | 12.5 |
| | (13.6) | (3.2) | (0.37) |
| Searched outside region | 14.9 | 38.2 | -23.3 |
| | (10.2) | (4.5) | (0.04) |
| Searched abroad | 11.9 | 13.0 | -1.1 |
| | (11.0) | (3.2) | (0.92) |
| Overtime | 28.6 | 32.1 | -3.5 |
| | (13.6) | (4.2) | (0.81) |
| Capital substitution | 12.9 | 6.9 | 6.0 |
| | (11.8) | (2.5) | (0.62) |
| Other | 1.6 | 4.2 | -2.6 |
| | (1.6) | (2.0) | (0.32) |

a. The significance of a test that the means are the same.

### *Solving Shortages*

Even when shortages of skilled workers exist, they may not be very serious. Gingras and Roy (1998) note that while 75% of employers in a 1995 Quebec survey indicated that they experienced hiring difficulties, fewer than 10% considered the situation sufficiently serious to justify raising wages, increasing overtime, or limiting production. In this section, we ask whether perceived occupational shortages outlined in the *1993 Innovation and Advance Technology Survey* elicited specific action by firms.

Shortages that threaten technology adoption can be addressed in various ways. On the one hand, new employees can be hired. On the other hand, existing employees can be trained. Alternately, a plant can turn to outsourcing to obtain materials and components that it cannot itself produce due to a lack of skilled personnel. The success of these alternatives in dealing with personnel shortages will affect the ability of plants to adopt advanced technologies. If these problems prove too costly, technology acquisition will have to be deferred.

It is significant that there were relatively few plants among both technology-users and non-users (less than 20%) who indicated that skill shortages in the categories listed led to a deferment of the adoption of advanced technologies (Table 4). Skill shortages in particular occupational categories may create problems but, for the most part, they are resolvable.

Various methods were used to respond to shortages of skilled staff. The two most important methods were to sub-contract work and to train existing staff. Using overtime, improving wages, and searching for staff were the next most important options, though these approaches were undertaken by significantly smaller proportions of firms.

Compared to technology non-users, technology users were more likely to train and to search outside of their region. The latter difference is particularly significant.[14] Technology non-users were more likely to increase wages and benefits to overcome their skill shortages. The difference in these strategies reflects the relative scarcity of the different types of skills needed in the two groups. When skilled workers of the type necessary to overcome shortages exist in the immediate vicinity of a plant, raising wages can attract them. When the types of skills are scarcer, plants have to search further afield or create the skills they need through training. That technology-using plants adopt the latter course of action indicates that the skill problems faced by this group are considerably different from technology non-users.

## 5. Training as a Response to the Use of Advanced Equipment

Training is a critical component of a business's human resource strategy. Effective training in any form has the potential to reduce the need to recruit from outside the firm—often a time-consuming and expensive process. Training also helps retain current employees through its effects on morale. In advanced technology-using firms where the skill requirements are increasing, the introduction of new processes or equipment can be less disruptive to production systems when accompanied by employee training. Finally, training can be used to develop firm-specific skills that are not available in the general labour market.

Advanced technology use and innovativeness have been found elsewhere to be strongly linked to a firm's training activities. Firms that use advanced technologies, that are innovative, or that both use these technologies *and* innovate often require knowledge and abilities that are difficult to acquire through external recruitment. Training is required because the specialized skills that are needed to operate technologically advanced equipment are not readily available outside a firm and the rapid change associated with innovation requires continual upgrading of employees (Baldwin and Johnson, 1996a; Baldwin, Gray and Johnson, 1996). Thus, we would expect businesses that fall into both of these categories—which are both technology-users and innovative—to place more emphasis on training than do businesses with just one or none of these characteristics.

In the previous section, we investigated whether training was one of the options used to respond to shortages of certain skilled personnel. The *1993 Innovation and Advanced Technology Survey* also provides information on whether training was introduced in response to the introduction of advanced equipment or software, since skill shortages may arise for reasons other than just the lack

[14] The high standard errors for technology non-users are the result of low response rates to this question for this group of firms. This is symptomatic of problems in response rates from this group of firms for questions that deal with impediments relating to technology acquisition. Because technology non-users have less experience with problems related to technology acquisition, the precision of our estimates in these areas is always lower than for technology users.

of certain type of personnel. Skill shortages may develop for a wide class of workers when new tasks are required of them, especially when new advanced technologies are introduced.

Data on whether technical/production staff had received training as a result of the introduction of advanced equipment or software (a classification that includes the advanced technologies examined in the survey, but is not restricted to them) confirm the link between technology use, innovation and training (Table 5). Only 24% of technology non-users provided training when they introduced any form of advanced equipment or software. Some 55% of non-innovative technology users did so. But an even greater proportion of more innovative technology users (79%) provided training when advanced equipment was introduced. All the differences are statistically significant.[15]

**Table 5.** Training provided to technical or production staff

| | **Technology non-users** | **Technology-using innovators** | **Technology-using non-innovators** |
|---|---|---|---|
| | *Percentage of plants (standard errors in brackets)* | | |
| *Yes* | 23.7<br>(2.5) | 78.7<br>(1.7) | 55.0<br>(7.7) |

Once again, there is a marked difference between technology users and non-users. But equally important, innovators have an even greater need for training than non-innovators within the class of technology users.

This greater difference between innovators and non-innovators in the rate of training in response to workplace changes associated with the introduction of new techniques likely reflects differences in the environment brought on by innovation. Plants indicating that they are technology users but that are not introducing innovations are more likely to just be implementing off-the-shelf techniques and equipment. Innovators, on the other hand, are using this new equipment either to develop new processes, or are introducing new products. These activities are more complex, require more new skills and are more likely to be accompanied by training.

The differences between innovators and non-innovators may also reflect differences in occupational profiles of the two groups, which in turn probably reflect differences in their environment. Different plant-based occupational profiles can result in different training profiles. Technology-using non-innovative plants were significantly more likely to have positions in the skilled trades' category than were technology-using innovative plants (see Table 2). This category includes such occupations as machinists, numeric control machine operators, printed circuit board assemblers and EDP equipment operators—essentially production employees. Using the same *1993 Survey of Innovation and Advanced Technology*, Baldwin and Da Pont (1996) report that innovative firms are more likely to have indicated that innovation increased the skill requirements for non-production workers than for production workers. Therefore, the changes occurring at both types of technology-using plants are likely to have had a lesser impact on the need to train skilled trades-people than they have had on other employees. Since there are more of the skilled trades-people in the non-innovative technology-using plants, there is less of a need for training for this group of plants. There are other

[15] See Appendix Table 5-A for tests of significance for the differences.

explanations for these differences. First, this group of workers may be more readily found by job-market searches. Second, these types of occupations might also be filled through apprenticeship programs, offered by institutions outside the firm.

## 6. *Human Resource Impediments to Technology Acquisition*

While skill shortages may arise because of a lack of personnel to fill specific jobs, they can also result from a more general need to upgrade the capability of most employees in order to deal with the problems that arise in an innovative environment—what some have referred to as a knowledge economy. Innovation requires not just a set of new and advanced occupations; it also requires that existing occupations solve different types of problems—problems that are highly specific to the type of innovation profile that a firm adopts. This can result in a general need to train many types of employees.

In order to investigate the extent to which shortages and training were a general problem, we turn to a question that was put to the plant about impediments to advanced technology acquisition. Both technology users and non-users were asked to report whether certain problems impeded their adoption of advanced technologies. The impact of each of these is summarized in Table 6, which outlines the percentage of plants that reported a problem in the human resource area.

While technology non-users faced few shortages in the specific occupational categories examined (Table 2), they find skill shortages just as important as the other two groups of plants when we do not restrict our attention to a limited set of occupations. In Table 6, there is just as high a proportion of technology non-using plants as technology-using plants reporting that they faced skill shortages.[16] Skill shortages are clearly an ongoing problem to all plants, regardless of their experience with the adoption of new technologies—though, as the previous section has shown, technology users become more active in seeking a specific type of worker in highly-skilled occupations as new advanced technologies are introduced.

There are, however, three other areas that distinguish technology non-users from users. Hands-on experience with technology adoption influences a firm's assessment of certain problems encountered during the adoption process. The technology-using plants are more likely to indicate that labour contracts and worker resistance are impediments to technology acquisition. They are also more likely to report that they faced training difficulties.

Table 6 reveals that for three of four human-resource-related impediments, there is little to distinguish innovators who use advanced technologies from non-innovators who also use them. Between 22% and 26% of both groups reported that skill shortages and training difficulties had impeded their technology acquisition. Worker resistance posed about the same problem to both—one that is important to between 11% and 13% of firms. The one area in which there are statistically

[16] See Table 6-A in the appendix for tests of the significance of these differences.

significant differences is labour contracts. Labour contracts were more important as a source of impediments to innovators—though only 11% indicated this was much of a problem.[17]

It should be noted that there is much less of a difference between technology non-users and users in the percentage of plants indicating that they faced training difficulties than there were in the actual percentage of firms performing training. The large difference in training rates between technology-using plants and plants where advanced technologies are not used helps to explain why technology non-using plants were significantly less likely to report that training difficulties had hampered the introduction of advanced technologies. Experience with an activity like training or adopting technology is directly related to the likelihood that a plant will experience problems while performing that activity. Therefore, it is understandable that non-users of advanced technology will be less likely to report experiencing training difficulties.[18]

**Table 6.** Impediments to technology acquisition

| | **Technology non-users** | **Technology-using innovators** | **Technology-using non-innovators** |
|---|---|---|---|
| | *Percentage of plants (standard errors in brackets)* | | |
| Shortage of skills | 21.5 | 25.1 | 22.9 |
| | (1.7) | (1.8) | (3.3) |
| Training difficulties | 16.5 | 22.0 | 25.7 |
| | (1.5) | (1.8) | (3.4) |
| Labour contracts | 5.0 | 10.5 | 4.3 |
| | (0.8) | (1.2) | (1.4) |
| Worker resistance | 9.2 | 13.3 | 11.1 |
| | (1.2) | (1.4) | (2.5) |

## *7. The Nature of Training: Different Paths for Innovators and Non-innovators*

Large proportions of both innovating technology-users (79%) and non-innovating technology users (55%) provided training to their technical or production staff when new technologies were introduced. Training will be done on-the-job when it is highly situation specific or in a classroom when it is not. Differences in the location of training of technology-using and non-using groups indicate that they differ in the type of training they provide (Table 7).

For innovators, the preferred types of training are, in descending order: on-the-job, classroom in firm, classroom outside of firm, and via correspondence. For non-innovators the order is: classroom in firm, classroom outside of firm, on-the-job and correspondence.

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[17] The survey did not pursue what the specific problem was about labour contracts that led to impediments.

[18] See Baldwin and Lin (2001) for a more extensive discussion of why technology users report that they face more impediments in a wide range of areas than do technology non-users.

Technology-using innovators then prefer on-the-job training to training performed elsewhere. The large and statistically significant difference between innovating and non-innovating technology users in this area suggests that there are differences in the type of skills that training is intended to impart in each case.[19]

**Table 7.** Type of training provided to technical/production employees

| Type of Training | Technology-using innovators | Technology-using non-innovators | Difference between Technology-using innovators versus Technology-using non-innovators |
|---|---|---|---|
| | ***Percentage of plants*** (standard errors in brackets) | | ***Percentage of plants*** (probability value)[a] |
| Classroom in firm | 51.7 | 51.2 | 0.5 |
| | (2.3) | (10.0) | (0.96) |
| Classroom outside firm | 44.7 | 48.5 | -3.8 |
| | (2.3) | (10.1) | (0.71) |
| On-the-job | 66.3 | 43.6 | 22.7 |
| | (2.2) | (10.0) | (0.03) |
| Correspondence | 7.4 | 3.5 | 3.9 |
| | (1.3) | (2.6) | (0.18) |

a. The probability of significance for a test that the means are the same.

Firms need to adopt training programs within the firm when their skill requirements are highly firm-specific or when they are rare, thus making it difficult to find help outside the firm to develop the training program. Leading firms have found a way to succeed that other firms have not found: leading firms grow to occupy first place in their industry because they have special knowledge that is perhaps best imparted on-the-job. Baldwin, Gray and Johnson (1996) argue that the leading firms in an industry, which would include innovative firms, would deliver training that develops firm-specific skills such as one would expect to occur through on-the-job or on-site training. They find evidence supporting this hypothesis from the *1989 Survey of Advanced Technology.*

The data used here from the *1993 Survey of Innovation and Advanced Technology* confirm and extend our earlier findings. The preferred training location for each of the two groups of technology-using plants is in the firm. But innovators are most likely to be training in a highly plant-specific environment—by doing so on-the-job. We infer that technology-using innovators are delivering training to their technical and production staff that is probably both sophisticated and highly plant-specific. As a result, these plants prefer to deliver training programs on-site—either on-the-job or in a classroom close at hand. In comparison, non-innovators are possibly imparting skills that are sophisticated but relatively non-plant specific (i.e., can be taught elsewhere than on the shop floor).

[19] See Baldwin, Gray and Johnson (1996) for a discussion of the relationship between on-the-job training and advanced technology use.

## 8. Conclusion

We have shown that both innovation and technology use are strongly linked to the importance given to the training component of their human resource strategies. Innovation and technology use result in increased skill requirements for businesses—needs that can be met either by hiring new employees or by training existing employees. Meeting these new skill requirements by training employees overcomes problems that have been caused by unsuccessful recruitment or the need to upgrade a wide range of existing workers in response to the introduction of new technologies into the workplace.

This paper examines the ways that innovation status and technology use affect the training activities of manufacturing plants. We find that technology users, regardless of whether or not they were also innovators, experience similarities in both the nature and intensity of human resource difficulties related to shortages of workers in specific highly skilled occupations. These firms are more likely to have positions to fill in these occupations; they face greater shortages for these workers; and they are more likely to train workers in response to these shortages than are technology non-users.

Technology use, rather than innovation status, appears to have the strongest effect on the incidence of highly skilled positions and the type of actions that are taken when skill shortages occur. The similarities with regards to occupational shortages and the response thereto between the two groups (innovative and non-innovative) of technology-using plants are as noteworthy as are the differences between the technology-using plants and the technology non-users.

On the other hand, innovating and non-innovating technology users diverge with regards to the extent and nature of training that is undertaken in response to the introduction of new advanced equipment. Innovators are more likely to provide training for this purpose and prefer on-the-job training to other forms. Non-innovators are less likely to offer training under these circumstances and when they do, it is more likely classroom-based, either off-site or at the firm.

Thus, technology-using innovative firms are more likely to train their employees when new technologies are introduced than they are in response to a specific occupational skill shortages. Among innovators, training appears to be designed to impart firm-specific sophisticated skills that require on-the-job training, rather than more generic sophisticated skills associated with occupational shortages, which are perhaps more easily acquired through recruitment.

This is in direct contrast with technology-using non-innovative firms. Relative to their need for plant-specific skills, these firms offer training more to develop the type of generic skills that can be imparted in a classroom.

This study then emphasizes that training occurs for more than one reason. Shortages related to insufficient supply of certain professionals provide one rational for training. But it is not here that innovative firms stand out. Rather they appear to respond differentially to the introduction of new equipment by extensively implementing training that is highly firm-specific. This suggests that innovation requires new skills that are not so much occupation-specific (though that is no doubt present), but general cognitive skills that come from operating in an innovative environment that

requires improved problem-solving capabilities by many different members of the workforce. These problem-solving capabilities occur in a learning-by-doing setting—with hands-on experience.

There is a parallel here to the relationship that we have found elsewhere between the level of innovative activity and the impediments reported (Baldwin and Lin, 2001). Firms that are innovative meet problems that have to be solved and report these impediments more frequently than those firms that are not innovative. As a response to this, innovators train their personnel to solve these problems. The need for this training is widespread within the firm—and is as acute, if not more so, outside of normal shop-floor functions. Since it arises out of problem solving, it is associated with these problems and, therefore, is highly firm-specific in this sense.

Finally, it should be noted that both technology users and non-users regard skill shortages as equally problematic impediments. But technology users are more likely to regard training as an impediment. This is an activity that they use more intensely as a solution to skill shortages. The problems that they recount as impediments arise from their more intense training activity.

## *Appendix A: Tests for Differences Between Categories*

**Table 2-A.** Plants with highly-skilled staff positions—differences between point estimates

| Staff position | Technology non-users versus Technology-using innovators | Technology-using innovators versus Technology-using non-innovators | Technology non-users versus Technology-using non-innovators |
|---|---|---|---|
| | Differences in means *(probability in brackets)* | | |
| Professionals with university degree | -18.4<br>(0.00) | 0.0<br>(1.00) | -18.4<br>(0.05) |
| Technicians/technologists | -24.8<br>(0.00) | 4.5<br>(0.53) | -20.3<br>(0.01) |
| Skilled trades | -10.9<br>(0.02) | -16.7<br>(0.02) | -27.6<br>(0.00) |

**Table 3-A.** Plants with staff positions who had difficulty staffing them

| | Technology non-users versus Technology-using innovators | Technology non-users versus Technology-using non-innovators | Technology-using innovators versus Technology-using non-innovators |
|---|---|---|---|
| | Differences in percentage of plants with difficulty filling one or more positions *(probability in brackets )* | | |
| Professionals with university degree | -3.5<br>(0.08) | -1.5<br>(0.71) | 2.0<br>(0.62) |
| Technicians/technologists | -10.4<br>(0.00) | -6.3<br>(0.37) | 4.1<br>(0.55) |
| Skilled trades | -6.2<br>(0.00) | -6.2<br>(0.28) | 0.0<br>(1.00) |

**Table 5-A.** Training provided to technical or production staff

| | Technology non-users versus Technology-using innovators | Technology non-users versus Technology-using non-innovators | Technology-using innovators versus Technology-using non-innovators |
|---|---|---|---|
| | Differences in percentage of plants *(probability in brackets)* | | |
| *Yes* | -55.0<br>(0.00) | -31.3<br>(0.00) | 23.7<br>(0.00) |

**Table 6-A.** Impediments to technology acquisition

| | Technology non-users versus Technology-using innovators | Technology non-users versus Technology-using non-innovators | Technology-using innovators versus Technology-using non-innovators |
|---|---|---|---|
| | Differences in percentage of plants *(probability in brackets)* | | |
| Shortage of skills | -3.6<br>(0.15) | -1.4<br>(0.73) | 2.2<br>(0.55) |
| Training difficulties | -5.5<br>(0.02) | -9.2<br>(0.01) | -3.7<br>(0.33) |
| Labour contracts | -5.5<br>(0.00) | 0.7<br>(0.69) | 6.2<br>(0.00) |
| Worker resistance | -4.1<br>(0.03) | -1.9<br>(0.49) | 2.2<br>(0.44) |

## *Appendix B: Selected Questions from the 1993 Survey of Innovation and Advanced Technology*

a) From Section 3: the following two questions were used to determine whether the firm that owned a plant was innovative.

3.1. During the period 1989-91, did you introduce (or were you in the process of introducing) any PRODUCT or PROCESS innovations? Yes (√) No(√)

3.2. Please indicate (√) the categories of your innovative activities for the period 1989-91.

| | Product Innovations | | Process Innovations |
|---|---|---|---|
| Stage | Without change in manufacturing technology | With a simultaneous change in manufacturing technology | In manufacturing technology without product change |
| Introduced | | | |
| In progress | | | |

b) The technology questions can be found in Baldwin and Sabourin (1995). They ask whether plants are employing the technologies reported in Table 1.

c) From Section 8: the following question was used to determine whether a plant faced impediments to technology acquisition

8.1 Please indicate (√) which of the following factors have particular significance to your firm as IMPEDIMENTS to technology acquisition.

| Labour-related problems | |
|---|---|
| Shortage of skills | |
| Training difficulties | |
| Labour contracts | |
| | |
| Organizational problems | |
| Worker resistance | |

d) The following two questions were used to determine whether there were skill shortages and what the response was:

8.2. For each of the professional groups listed below, please indicate (√) first whether you have positions in your firm and, second, whether you are experiencing difficulty in filling any such positions.

| Profession | Staff positions? | Shortages? |
|---|---|---|
| Electrical engineers | | |
| Aerospace engineers | | |
| Engineering technologists and technicians | | |
| Systems analysts and computer programmers | | |
| Electronic data processing equipment operators | | |
| Assemblers, printed circuit boards | | |
| CAD draughtspersons | | |
| CAD/CAM repair technicians | | |
| CAD designers, printed circuit boards | | |
| Computer hardware specialists | | |
| Fibre-optic splicers | | |
| Laser-beam welders | | |
| Laser-tube assemblers | | |
| Machinists, numerically controlled machine tools | | |
| Microcomputer specialists | | |
| Numerical-control operators | | |
| Robotic technicians | | |
| Other | | |

8.3 Which (√) of the following steps have you taken to deal with these shortages?

| Steps taken | (√) |
|---|---|
| Deferred acquisition of technology | |
| Sub-contracted | |
| Given appropriate personnel training | |
| Improved wages, benefits | |
| Searched outside region | |
| Searched abroad | |
| Overtime | |
| Capital substitution | |
| Other | |

e) The following question was used to determine whether training was used as a response to the introduction of new technology.

8.4 During the period 1989-1991, have the technical and/or production employees of your plant received any training associated with your adoption of technologically advanced equipment and software? YES (√) or NO (√)

f) The following question was used to determine the type of training that was implemented.

8.5. Please specify the nature of this training.

| Nature | Average duration (days per trainee) | Number of trainees | Government-assisted? | |
|---|---|---|---|---|
| | | | YES | NO |
| Classroom in the firm | | | | |
| Classroom outside the firm | | | | |
| On-the-job training | | | | |
| Correspondence courses | | | | |

Note: This question was poorly answered. Therefore, we only captured whether there was any response in a given row when we measured which form of training was used. Catalogue 63-016-XPB, Vol. 1, No. 4. Ottawa: Statistics Canada.

## *References*

Baldwin, J.R. 1997. *The Importance of Research and Development for Innovation in Small and Large Canadian Manufacturing Firms*. Research Paper No. 107. Analytical Studies Branch. Ottawa: Statistics Canada.

Baldwin, J.R. 1999. *Innovation, Training and Success*. Research Paper No. 137. Analytical Studies Branch. Ottawa: Statistics Canada.

Baldwin, J.R. and M. Da Pont. 1996. *Innovation in Canadian Manufacturing Firms*. Catalogue No. 88-513-XPB. Ottawa: Statistics Canada.

Baldwin, J.R., G. Gellatly, J. Johnson and V. Peters. 1998. *Innovation in Dynamic Service Industries*. Catalogue No. 88-516-XPB. Ottawa: Statistics Canada.

Baldwin, J.R., T. Gray and J. Johnson. 1996. "Advanced Technology Use and Training in Canadian Manufacturing." *Canadian Business Economics* 5: Fall, 1996. 51-70.

Baldwin, J.R. and J. Johnson. 1995. *Human Capital Development and Innovation: The Case of Training in Small and Medium Sized Firms.* Research Paper No. 74. Analytical Studies Branch. Ottawa: Statistics Canada.

Baldwin, J.R. and J. Johnson. 1996a. "Human Capital Development and Innovation: The Case of Training in Small and Medium Sized Firms." In *The Implications of Knowledge-Based Growth for Micro-Economic Policies*. Edited by P. Howitt. Calgary : University of Calgary Press.

Baldwin, J.R. and J. Johnson. 1996b. "Business Strategies in Innovative and Non-Innovative Firms in Canada." *Research Policy* 25: 785-804.

Baldwin, J.R. and J. Johnson. 1999. "Innovator Typologies, Related Competencies and Performance." In *Microfoundations of Economic Growth.* Edited by G. Eliasson and C. Green. Ann Arbor: University of Michigan.

Baldwin, J.R. and Z. Lin. 2001. *Impediments to Advanced Technology Adoption for Canadian Manufacturers*. Research Paper Series. Analytical Studies Branch. Ottawa: Statistics Canada. Forthcoming.

Baldwin, J.R. and D. Sabourin. 1995. *Technology Adoption in Canadian Manufacturing*. Catalogue No. 88-512-XPB. Ottawa: Statistics Canada.

Baldwin, J.R. and D. Sabourin. 1997. "Factors Affecting Technology Adoption: A Comparison of Canada and the United States." *Canadian Economic Observer*. Catalogue no. 11-010-XPB. Ottawa : Statistics Canada. August pp. 3.1-3.17.

Baldwin, J.R., D. Sabourin and M. Rafiquzzaman. 1996. *Benefits and Problems Associated with Technology Adoption*. Catalogue No. 88-514-XPE. Ottawa: Statistics Canada.

Gingras, Y. and R. Roy. 1998. "Is there a Skill Gap in Canada?" Research Paper R98-9E. Applied Research Branch, Strategic Policy, Human Resources Development Canada.

Organization for Economic Co-operation and Development (OECD). 1998. *Human Capital Investment*. Paris.

Roy, R., H. Henson and C. Lavoie. 1996. "A Primer on Skill Shortages in Canada." Research Paper R-96-8E. Applied Research Branch. Strategic Policy, Human Resources Development Canada.

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